Method, System, and Apparatus for Balanced Frequency Up-Conversion of a Baseband Signal and 4-Phase Receiver and Transceiver Embodiments.

In the Claims:

Please cancel claims cancel claims 8, 9, 10, 12-14, 17-21, 28, 29, 32, 33, 39, 40, 43, 44, 52, 53, 65, 66, 71, 72, 76, 84, 89, 90, and 95.

Please amend claims 1, 22, 38, 42, 46, 75, 83, 85, and 92.

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1. (Once Amended) A method for up-converting a baseband signal, comprising the steps of:

(1) receiving the baseband signal; and

(2) differentially sampling the baseband signal according to a first control signal and a second control signal resulting in a plurality of harmonic images that are each representative of the baseband signal.

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22. (Once Amended) A method of up-converting a baseband signal, comprising the steps of:

(1) receiving a baseband signal and an inverted baseband signal;

(2) sampling the baseband signal according to a first control signal to generate a first harmonically rich signal;

(3) sampling said inverted baseband signal according to said second control signal to generate a second harmonically rich signal, wherein said second control signal is phase shifted relative to said first control signal; and

(4) combining said first harmonically rich signal and said second harmonically rich signal to generate a third harmonically rich signal having harmonic images that are representative of said baseband signal.

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38. (Once amended) A method of up-converting a baseband signal, comprising the steps of:

(1) receiving a baseband signal and an inverted baseband signal;

(2) adding a common reference voltage to the baseband signal and the inverted baseband signal, to generate a first combined signal and a second combined signal, respectively;

(2) sampling said first combined signal according to a first control signal to generate a first harmonically rich signal;

(3) sampling said second combined signal according to said second control signal to generate a second harmonically rich signal, wherein said second control signal is phase shifted approximately 180 degrees relative to said first control signal; and

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(4) combining said first harmonically rich signal and said second harmonically rich signal to generate a third harmonically rich signal having harmonic images that are representative of said baseband signal;

wherein said pulses of said first and second control signals have a pulse width of T_A, and wherein an amplitude of said harmonics in said third harmonically rich signal are based on $n*(T_A/T_S)$, where T_S is a period of said first and second control signal, and n is a harmonic number of said harmonic.

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42. (Once Amended) A method of up-converting a baseband signal, comprising the steps of:

(1) receiving a baseband signal and an inverted baseband signal;

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(2) adding a common reference voltage to the baseband signal and the inverted baseband signal, to generate a first combined signal and a second combined signal, respectively;

(2) shunting said first combined signal to ground according to a first control signal to generate a first harmonically rich signal;

(3) shunting said second combined signal to ground according to said second control signal to generate a second harmonically rich signal, wherein said second control signal is phase shifted approximately 180 degrees relative to said first control signal so that second combined signal is not shunted to ground simultaneous with said first combined signal; and

(4) combining said first harmonically rich signal and said second harmonically rich signal to generate a third harmonically rich signal having harmonic images that are representative of said baseband signal;

wherein said pulses of said first and second control signals have a pulse width of T_A, and wherein an amplitude of said harmonics in said third harmonically rich signal are based on $n*(T_A/T_S)$, where T_S is a period of said first and second control signal, and n is a harmonic number of said harmonic.

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46. (Once Amended) A method of transmitting an IQ signal, the method comprising the steps:

(1) receiving an I baseband signal and a Q baseband signal;

(2) differentially sampling the I baseband signal according to a first control signal and a second control signal, to generate an I harmonically rich signal;

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(3) differentially sampling the Q baseband signal according to said first control signal and said second control signal, to generate a Q harmonically rich signal; and

(4) combining said I harmonically rich signal and said Q harmonically rich signal, to generate a IQ harmonically rich signal, said IQ harmonically rich signal having multiple harmonic images that contain information for reconstruction of the I and Q baseband signals.

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75. (Once Amended) A system for up-converting a baseband signal, comprising:

means for inverting said baseband signal, resulting in an inverted baseband signal;

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first sampling means for sampling said baseband signal according to a first control signal, resulting in a first harmonically rich signal;

second sampling means for sampling said inverted baseband signal according to a second control signal, resulting in a second harmonically rich signal; and

means for combining said first harmonically rich signal and said second harmonically rich signal, resulting in a third harmonically rich signal, wherein said third harmonically rich signal contains multiple harmonic images that are each representative of said baseband signal;

wherein said first and second control signals have a period of T_S so that said harmonic images repeat at multiples of $1/T_S$;

wherein said second control signal is phase shifted relative to said first control signal;

wherein said first and second control signal comprise pulses having an associated pulse width T_A.

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83. (Once Amended) A system of transmitting an IQ signal, the method comprising the steps:

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(1) means for receiving an I baseband signal and a Q baseband signal;

(2) first differential sampling means for sampling the I baseband signal according to a first control signal and a second control signal, to generate an I harmonically rich signal, wherein said second control signal is phase shifted relative to said first control signal;

(3) second differential sampling means for sampling the Q baseband signal according to said first control signal and said second control signal, to generate a Q harmonically rich signal; and

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(4) means for combining said I harmonically rich signal and said Q harmonically rich signal, to generate an IQ harmonically rich signal, said IQ harmonically rich signal having multiple harmonic images that contain amplitude and frequency information for reconstruction of the I and Q baseband signals;

wherein said first and second control signals have a period of T_S so that said harmonic images repeat at multiples of $1/T_S$;

wherein said first and second control signal comprise pulses having an associated pulse width T_A.

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85. (Once Amended) An apparatus for transmitting a baseband signal, said apparatus comprising:

a buffer/inverter, for receiving said baseband signal and generating an inverted baseband signal;

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a terminal for receiving a reference voltage;

a first summer, coupled to a first output of said buffer/inverter and said terminal, said first summer summing said reference voltage with said baseband signal and resulting in a first combined signal;

a second summer, coupled to a second output of said buffer inverter and said terminal, said second summer summing said reference voltage with said inverted baseband signal and resulting in a second combined signal;

a first controlled switch, coupled to an output of said first summer, said first controlled switch sampling said first combined signal according to a first control signal, and resulting in a first harmonically rich signal;

a second controlled switch, coupled to an output of said second summer, said second controlled switch sampling said second combined signal according to a second control signal, and resulting in a second harmonically rich signal; and

a combiner, coupled to an output of said first controlled switch and an output of said second controlled switch, said combiner combining said first harmonically rich signal and said second harmonically rich signal, resulting in an third harmonically rich signal;

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wherein said first control signal and said second control signal comprises pulses having a pulse width T_A;

wherein said first control signal and said second control signal are phase shifted with respect to each other.

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92. (Once Amended) An apparatus for transmitting a baseband signal, said apparatus comprising:

a buffer/inverter, for receiving said baseband signal and generating an inverted baseband signal;

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a first controlled switch, coupled to an output of said buffer/inverter, said first controlled switch shunting said baseband signal to ground according to a first control signal, and resulting in a first harmonically rich signal;

a second controlled switch, coupled to a second output of said buffer/inverter, said second controlled switch shunting said inverted baseband signal to ground according to a second control signal, and resulting in a second harmonically rich signal; and

a combiner, coupled to an output of said first controlled switch and an output of said second controlled switch, said combiner combining said first harmonically rich signal and said second harmonically rich signal, resulting in an third harmonically rich signal;

wherein said first control signal and said second control signal comprises pulses having a pulse width T_A;

wherein said first control signal and said second control signal are phase shifted with respect to each other.
